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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/607,216	06/27/2003	Atsuko Kawasaki	09108.0002	5695

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Finnegan, Henderson, Farabow,  
Garrett & Dunner, L.L.P.  
1300 I Street, N.W.  
Washington, DC 20005-3315

EXAMINER
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DIAZ, JOSE R

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 03/23/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/607,216	<b>Applicant(s)</b> KAWASAKI ET AL.	
	<b>Examiner</b> José R. Díaz	<b>Art Unit</b> 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 03 January 2005.
- 2a) ☒ This action is **FINAL**.      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-5 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al. (US 2004/0106292 A1) in view of Applicant's admitted prior art.

Regarding claim 1, Sato et al. teaches a method of producing semiconductor devices, comprising the steps of:

forming an etching resistive mask (consider the oxide film 2 and the nitride film 3) over a semiconductor substrate (1) (see fig. 2);

etching said semiconductor substrate through an opening (5) in said etching resistive mask to form a device isolation trench (6a) (see figs. 5-7);

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forming a coat of a silazane perhydride polymer solution ("polysilazane" 6c)<sup>1</sup> over said semiconductor substrate having said device isolation trench formed therein (see figs 10-11 and line 16 of paragraph [0055]);

modifying the silazane perhydride polymer solution into a film of silicon oxide (see lines 18-19 of paragraph [0055]: "The coating film 6c is made of silicon oxide...");

removing said film of the silicon oxide (6c) leaving a residue inside said device isolation trench (see figs. 12-13 and lines 5-8 of paragraph [0056]); and

heating (thermal processing) said silicon oxide left in said device isolation trench for densification, which inherently removes impurities (see lines 8-12 of paragraph [0056]).

However, Sato et al. fails to teach the steps of vaporizing a solvent from said coat and subjecting said coat to chemical reaction. Applicant teaches that it is well known in the art to modify the silazane perhydride polymer solution into a film of silicon oxide prior to densification by vaporizing a solvent from said coat and then, subjecting said coat to chemical reaction (see page 1, lines 30-31 and 33-36).

Applicant's admitted prior art and Sato et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the film of silicon oxide by vaporizing a solvent from said coat and then, subjecting said coat to chemical reaction. The motivation for doing so, as is taught by Applicant's admitted prior art, is to

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<sup>1</sup> Please note that "silazane perhydride polymer" and "polysilazane" have the same chemical composition. For instance, Koyanagi (US Pat. No. 6,191,002 B1) in column 8, line 1 discloses the composition of the "silazane perhydride polymer" is  $[(SiH_2NH)_n]$ , and also, Nishiyama et al. (US 2003/0022522 A1) discloses the same composition in paragraph [0052] for "polysilazane."

reduce crack formation in the silicon oxide film (page 2, lines 10-12). Therefore, it would have been obvious to combine Sato et al. with Applicant's admitted prior art to obtain the invention of claim 1.

4. Claims 2-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al. (US 2004/0106292 A1) in view of Applicant's admitted prior art, and further in view of Ahn (US Pat. No. 6,596,607 B2).

Regarding claims 2-3, a further difference between the prior art and the claimed invention is the step of forming a silicon oxide film over the surface of the etching resistive mask containing silicon nitride after the formation of the device isolation trench, before forming the coat of silazane perhydride polymer solution, and after etching said silicon nitride to etch back opening edges. Ahn teaches that it is well known in the art to further include a silicon oxide film (109) over the surface of the etching resistive mask containing silicon nitride (103) (see fig. 6) after the formation of the device isolation trench (121) (see figs. 5-6), before forming the coat of silazane perhydride polymer solution (119) (see fig. 6 and col. 4, lines 20-27 and 32-35), and after etching said silicon nitride (103) to etch back opening edges (see fig. 5 and col. 4, lines 8-10 and 13-15).

Applicant's admitted prior art, Sato et al. and Ahn are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form a silicon oxide film over the surface of the etching resistive mask containing silicon nitride,

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after the formation of the device isolation trench, before forming the coat of silazane perhydride polymer solution, and after etching said silicon nitride to etch back opening edges. The motivation for doing so, as is taught by Ahn, is to provide an oxide barrier layer, which protects the silicon nitride layer during the oxidation process of the silazane perhydride polymer solution (col. 4, lines 23-26). Therefore, it would have been obvious to combine Sato et al. with Applicant's admitted prior art to obtain the invention of claims 2-4.

Regarding claim 4, Ahn further teaches that the silicon oxide layer is formed by low pressure CVD (see col. 4, lines 20-23).

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al. (US 2004/0106292 A1) in view of Applicant's admitted prior art, and further in view of Koyanagi (US Pat. No. 6,191,002 B1).

Regarding claim 5, a further difference between the prior art and the present application is removing the film of silicon oxide by CMP. Koyanagi teaches that it is well known in the art to remove silicon oxide by CMP (see col. 8, lines 61-63).

Applicant's admitted prior art, Sato et al. and Koyanagi are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to remove silicon oxide by CMP. The motivation for doing so, as is taught by Koyanagi, is to flat the top surface of the oxide film (col. 8, lines 65-67). Therefore, it would have

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been obvious to combine Koyanagi with Sato et al. and Applicant's admitted prior art to obtain the invention of claims 5.

### ***Response to Arguments***

4. Applicant's arguments with respect to claim 5 have been considered but are moot in view of the new ground of rejection. In addition, applicant argues that Sato does not teach a silicon oxide layer. However, the examiner disagrees. As far as understood, Sato does disclose the formation of a silicon oxide layer in paragraph [0055]. Specifically, lines 15-16 of paragraph [0055], Sato explicitly states that the deposited coating film 6c is "an inorganic spin-on glass (SOG) film of polysilazane." In other words, the coating film 6c is a silicon oxide (e.g. glass) film formed from a polysilazane solution. Thus, the rejection is proper since Sato teaches a silicon oxide film formed by modifying a polysilazane solution.

### ***Conclusion***

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Hong et al. (US Pat. No. 6,566,229 B2) teaches coating a polysilazane solution to form a SOG layer (see abstract).

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

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§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

### ***Correspondence***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to José R. Díaz whose telephone number is (571) 272-1727. The examiner can normally be reached on Monday through Thursday.

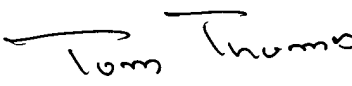
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.



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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JRD  
3/21/05

  
TOM THOMAS  
SUPERVISORY PATENT EXAMINER